A SURVEY OF INDUSTRIAL ENGINEERING PRACTICES IN INDUSTRY.

BY

JAMES GALE WILSON

THESIS
W638

U. S. Naval Postgraduate School
Monterey, California

A SURVEY OF INDUSTRIAL ENGINEERING PRACTICES IN INDUSTRY

A Thesis

Submitted to the Faculty

of

Purdue University

by

James Dale Wilson

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Science

in

Industrial Engineering

May, 1953

Thesis
W(c3

ACKNOWLEDGMENTS

This survey required the cooperation of a large number of companies and individuals throughout the United States. I wish to express my appreciation to all of those who furnished the information which made this survey possible.

I wish also to thank Professor P. F. Ralyeat for his inspiration and guidance, without which this survey could not have been made.

Special thanks are due my wife for her help in tabulating the large amount of data received, and for typing this thesis.

20517

TABLE OF CONTENTS

Page

ABSTRACT

INTRODUCTION 1

OBJECTIVES 3

PROCEDURE 4

Design of questionnaire 4

Distribution of questionnaire 6

Mailing list 12

Analysis of Replies 12

RESULTS AND ANALYSES 13

Response to Questionnaire 13

Analysis of Ranking 17

Questions 1, 3, & 4 17
Question 2 18
Question 5 27
Question 6 29
Question 7 30
Question 8 30
Question 9 38
Question 10 43
Concepts of Industrial Engineering Functions 47
Industrial Engineering Practices 47

CONCLUSIONS 54

LISTS OF TABLES AND FIGURES

List of Tables

Table		Page
1.	Industry types	9
2.	Geographic areas of the United States	10
3.	Questionnaire distribution	11
4.	Number of replies received	14
5.	Percentage of questionnaires answered	15
6.	Distribution of replies received by company size	16
7.	Answers to part 1 of question 5 by industry type	18
8.	Answers to question 5 by geographical area	19
9.	Answers to question 5 by number of employees	20
10.	Employment of graduate Industrial Engineers related to existence of formal Industrial Engineering department - by industry type	21
11.	Employment of graduate Industrial Engineers related to existence of formal Industrial Engineering department - by geographical area	22
12.	Employment of graduate Industrial Engineers related to existence of formal Industrial Engineering department - by company size	23
13.	Utilization of Industrial Engineers by industry type	24
14.	Subjects included in college Industrial Engineering curricula in order of importance as reported by 23 educators	26
15.	Subjects frequently included in college Industrial Engineering curricula in order of importance as reported by industry	27
16.	Additional subjects suggested by industry for inclusion in college Industrial Engineering curricula	29
17.	Existence of formal Industrial Engineering department as related to type of industry	31
18.	Existence of formal Industrial Engineering department as related to geographic area and company size	32

List of Tables

Table		Page
19.	Size of Industrial Engineering departments compared with size of companies	33
20.	Titles used for heads of formal Industrial Engineering Departments	34
21.	Titles used for heads of special departments performing Industrial Engineering functions	35
22.	Titles of company officers to whom heads of formal Industrial Engineering departments report	36
23.	Titles of company officers to whom heads of special departments performing Industrial Engineering functions report	37
24.	Opinions regarding the place of the Chief Industrial Engineer in the company organization - by type of industry	39
25.	Opinions regarding the place of the Chief Industrial Engineer in the company organization - by geographic area and company size	40
26.	Opinions regarding responsibility for the coordination and utilization of men, materials, and machines to achieve the most economical production	41
27.	Opinions regarding responsibility for the coordination and utilization of men, materials, and machines to achieve the most economical production in industries having Industrial Engineering departments or special departments performing Industrial Engineering functions	42
28.	Opinions regarding responsibility for the coordination and utilization of men, materials, and machines to achieve the most economical production in industries not having Industrial Engineering departments or special departments performing Industrial Engineering functions	44
29.	Utilization of "Industrial Engineering" consultants by type of industry	45
30.	Utilization of "Industrial Engineering" consultants by geographical area and company size	46
31.	Concepts of Industrial Engineering functions	48
32.	Industrial Engineering department functions in industry	49

List of Tables

Table | Page

33. "Industrial Engineering" functions performed by departments other than formal Industrial Engineering department 50

List of Figures

Figure | Page

1. Questionnaire 5

2. Letter sent to manufacturers, public utilities, and department stores 7

3. Letter sent to educators and management consulting firms. 8

ABSTRACT

Because of the world growth and increasing acceptance of industrial engineering as a separate branch of engineering, it is important that the field be adequately explained and defined. To accomplish this it is necessary to evaluate the existing industrial engineering concepts and practices.

This thesis is an attempt to provide information concerning the existing industrial engineering concepts and practices in a representative segment of industry and education. This information should be helpful in creating a better understanding of the industrial engineering field.

The approach used was to survey a large number of companies throughout the United States. This involved the development and formulation of a questionnaire to a selected group of companies and the tabulation and analysis of the answers received. The questionnaire was designed to gather pertinent factual information concerning the training and utilization of industrial engineers, the company's organization, and the significance of generally accepted industrial engineering functions.

[illegible] questionnaires were sent to manufacturers in various types of industry throughout the United States. [illegible] questionnaires were sent to educators in the field of industrial engineering. [illegible] questionnaires were sent to consultant and industrial engineering consulting firms.

Of the [illegible] questionnaires sent out, [illegible] were returned.

Some of the facts brought out in the analysis of the data are:

1. [illegible] practically everything, [illegible] formal industrial

engineering department; 2) have several departments offering graduate level industrial engineering curricula; and 3) have no industrial engineering department of any kind.

2. Of the considered variables, the number of full time graduate industrial engineers was approximately three times greater for the group of schools with both graduate and undergraduate industrial engineers.

3. The average number of graduate industrial engineers per school was 1.6.

4. The average number of graduates per graduate engineering school was 16.

5. Nearly half of the 1615 total engineers employed in the metal working and electrical equipment industries.

6. Most of the engineering graduates who joined industrial engineering to be a member of "the management" as revealed by only 4% of the graduates.

7. The heads of the industrial engineering departments with graduate degrees differ in the first choice of the greatest problem of the country.

8. There is criticism by the businessmen that there is between the opinions of educators and industry concerning the training needs of graduate industrial engineers.

9. The curriculum and course outlines in industrial engineering departments are time study, wage setting, job evaluation, office and plant layout, work measurement, job evaluation, and process engineering.

A SURVEY OF INDUSTRIAL ENGINEERING PRACTICES IN INDUSTRY

INTRODUCTION

From its inception, American industry's record of achievement has been one of ever-increasing productivity and capacity. This outstanding record is due in part to the enormous contributions of this country's scientists. However, new scientific discoveries and the resulting technological changes have had one serious consequence. They have greatly increased the complexity of industrial operations.

While the importance of the engineer as a technician has been increasing, so, too, has the need for the engineer as an organizer or coordinator been increasing. Out of this need has grown the field of Industrial Engineering in which scientific and engineering methods are utilized to systematize and coordinate industrial activities.

Although the field of Industrial Engineering has received acceptance in many quarters, there seems to be little agreement as to its nature and scope. Some companies look upon it as the science of designing industrial control systems and coordinating the activities of an industry, while others identify Industrial Engineering with only one or two specific functions such as Time and Motion Study or Plant Layout.

Many universities have tried to keep pace with the ever-increasing demands of industry for graduates trained for Industrial Engineering positions. Unfortunately, the widespread lack of agreement as to the functions of Industrial Engineering makes it difficult for them to adjust their curricula to meet the diverse needs of industry.

It has been the experience of the writer that, in any discussion

of Industrial Engineering, the most frequent questions raised are: What is Industrial Engineering? What does an Industrial Engineer do? What training should a person have to qualify as an Industrial Engineer? It is evident that these questions must be answered and the existing differences of opinion resolved before any real progress in the Industrial Engineering field can be made.

OBJECTIVES

Professor R. T. Livingston of Columbia University makes the following statement concerning the importance of explaining the field of Industrial Engineering:

> Industrial Engineering . . . as a separate and distinct branch of Engineering is relatively new. In fact its growth to maturity, recognition and general acceptance is a postwar phenomenon. Because of this rapid growth there is not the same understanding of the field that there is of the other branches of Engineering. Because of its growth and its future potentialities it is important that the field be explained.[1]

The major objective of this thesis is to provide information concerning the existing Industrial Engineering concepts and practices of a representative segment of industry and educators. It is hoped that this information will be helpful in creating a better understanding of the Industrial Engineering field.

This information should also be useful to those companies contemplating the establishing of an Industrial Engineering department or the hiring of Industrial Engineers.

The final objective is to aid colleges in developing or revising their Industrial Engineering curricula to meet the needs of industry.

---

[1] Livingston, R. T., Reports in Industrial Engineering; New York, Columbia University, 1940, p.1.

PROCEDURE

After careful consideration it was decided that the best way to obtain information from a large number of companies would be by means of a questionnaire, distributed by mail. Accordingly, the procedure followed in preparing this thesis was to develop a questionnaire; mail it to a selected group of manufacturers, public utilities, department stores, management consultants, and educators; and analyze the information obtained.

Design of Questionnaire

A major consideration during the development of the questionnaire was to make it easy for the respondents to answer the questions and return them. The number of questions was kept to a minimum, and the majority of them could be answered simply by making a pencil check-mark. The rest required only one or two words to give a complete answer.

The finished questionnaire, as it was sent out, is shown in Fig. 1. It was printed on a single 10" x 14" sheet of paper, prefolded, addressed for return, and stamped with return postage. All the recipient needed to do was to answer the questions, fold the questionnaire, staple the open edge, and drop it in the mail. It was hoped that the use of stamps, rather than postage-meter stamping, for return postage would increase the number of replies. Air-mail stamps were attached to those questionnaires sent to companies in distant states in order to stimulate prompt answers.

A short letter, explaining the purpose of this thesis project and requesting cooperation with it, accompanied each questionnaire. The questionnaire was attached to the letter, and both were enclosed in

Completion of the following form will be helpful in outlining your company's concept of "Industrial Engineering" even though your company may not have an industrial engineering department. The functions listed in the form can generally be thought of as consisting of either or both of two phases of activity: First, DESIGN -- The study, planning and development of the methods, procedures, or systems required to control the performance of the function. Second, ADMINISTRATION -- The actual performance or control of the function utilizing the designed methods, procedures, or systems. Indicate an affirmative answer to questions (1) & (2) by checking either or both of the DESIGN - ADMIN. columns as applicable. In answering (3), if the separation of the function into the two phases involves more than one department, please indicate all of the departments concerned. Add to the list any other functions you consider pertinent as well as any explanatory remarks necessary.

Functions frequently associated with "Industrial Engineering"	(1) In your opinion is this an "Industrial Engineering" function?		(2) Does your "Industrial Engineering" department perform this function?		(3) If you do not check (2), please answer the following:		
	DESIGN	ADMIN.	DESIGN	ADMIN.	Department that performs this function?	Approximate number of persons actually performing this function?	Title of department head?
Production Planning & Scheduling							
Production Control							
Material Control							
Inventory Control							
Quality Control							
Office & Plant Layout							
Design of Equipment or Facilities							
Tool Engineering, Jigs & Fixtures							
Maintenance - Machinery & Equipment							
Maintenance - Building & Facilities							
Safety Programs							
Waste Elimination & Salvage							
Office Management & Procedures							
Process Engineering							
Methods Analysis & Standardization							
Personnel Policies & Procedures							
Training Programs - Supervisor							
Training Programs - Production worker							
Labor Relations - Grievance Settlement							
Job Evaluation							
Merit Rating							
Time Study							
Rate Setting							
Wage Incentive Systems							
Cost Estimating - Production							
Cost Records & Control							
Special Projects							

Data submitted by: (Name) _____ (Title) _____

INDUSTRIAL ENGINEERING CONCEPTS & PRACTICES
- PURDUE UNIVERSITY SURVEY -

1. Name of Company_____

2. Approx. No. of Employees_____ 3. Company established (year) _____

4. If your company is either a Parent Company or a Subsidiary: (check one)
Parent Company retains MAJOR ( ), MINOR ( ) control over the organization structure and management practices of its subsidiary.

5. Does your company hire college graduates who have "Industrial Engineering" or "Industrial Engineering - Option" degrees? Yes_____ No _____
If yes: Approximately how many are now employed? _____

6. The following is a composite list of subjects frequently included in college "Industrial Engineering" curricula offered to engineering or management students. Using the suggested code, indicate those subjects you think would be of value in the training of college graduates hired by your company to perform "Industrial Engineering" or "Management" functions: CODE: 1 Essential 2 Of some value 3 Unimportan

____ Chemistry	____ Govt., Political Sci.	____ Plant Layout
____ Mathematics	____ Finance	____ Production Eng.
____ Physics	____ Economics	____ Operation Analysis
____ Mechanics	____ Industrial Economics	____ Motion & Time Study
____ Fluid Mechanics	____ Accounting	____ Engineering Economy
____ Thermodynamics	____ Business Law	____ Production Planning
____ Surveying	____ Labor Rel., Personnel	____ Production Control
____ Elec. Engineering	____ Wages, Job Evaluation	____ Statistics
____ Metallurgy	____ Technical English	____ Quality Control
____ Eng. Materials	____ Technical Writing	____ Human Engineering
____ Strength of Mat'ls	____ Surveys & Reports	____ Safety Engineering
____ Mech. Drawing	____ Industrial Reports	(others
____ Mechanisms	____ Ind'l. Org'n. & Mg't.	
____ Machine Design	____ Plant Operation	
____ Tool Engineering	____ Factory Planning	

7. Does your company's organization specifically include an "Industrial Engineering" department? Yes_____ No _____
If yes:
a. Title of the head of this department?_____
b. To whom does he report? (Title) _____
c. Approximately how many employees in this department?_____

8. Do you consider your Chief Industrial Engineer to be a member of "Top Management"?
Yes_____ No _____

9. Who do you feel should be responsible for the coordination & utilization of men, materials, and machines to achieve the most economical production?

_____

10. Does your company engage "Industrial Engineering" consultants: (check one)
Regularly_____ For special problems _____ Never _____

11. Would you like a summary of the results of this Survey? Yes_____ No_____

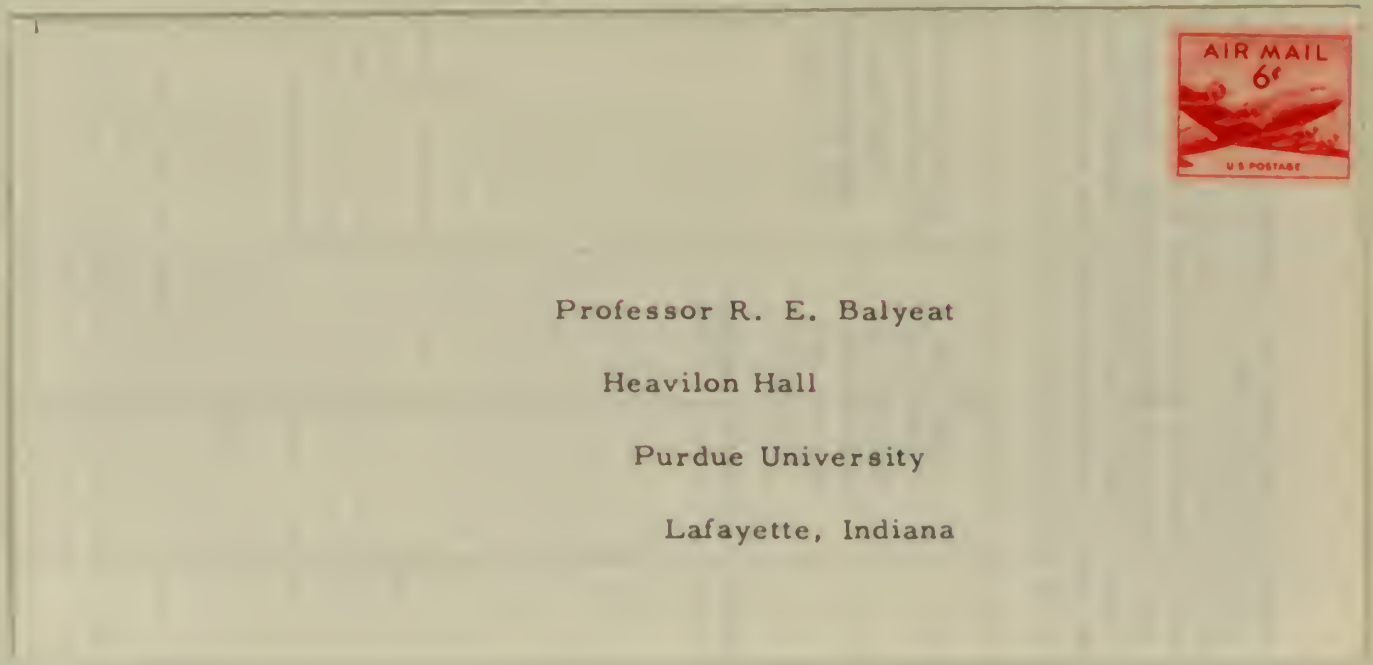

Fig. 1
Questionnaire

the same envelope. The letter sent to manufacturers, public utilities, and department stores is shown in Fig. 2. The letters sent to educators and management consulting firms were individually typed as shown in Fig. 3.

Distribution of Questionnaire

For convenience, the public utilities and department stores were considered part of the manufacturers group. Because of the low percentage of returns expected from a mailed questionnaire, it was felt that at least 1000 questionnaires would have to be distributed to manufacturers in order to get enough replies for a significant analysis. In addition, it was decided to send 17 questionnaires to management consultants in the major manufacturing centers, and 82 questionnaires to educators in the Industrial Engineering field.

Table 3 summarizes the distribution of the 1100 questionnaires actually sent out. The 1001 questionnaires sent to manufacturers were prorated on the basis of the total number of companies and employees in the United States, distributed by type of industry[2] and geographical location[3]. This information was obtained from the "Manufacturers" section of the Statistical Abstract of the United States, 1952[4].

Consideration was given to the possibility of basing the distribution on the number of employees in each company. However, this proved impractical since there was no readily usable or reliable information of this sort available. In preparing the actual mailing list, an attempt was made to achieve some distribution on this basis wherever there was

---

[2]The industry types are listed in Table 1.
[3]The geographical areas are listed in Table 2.
[4]U. S. Census Bureau: Statistical Abstract of the United States, 1952, Washington, D. C., Government Printing Office, 1952, pp. [illegible].

PURDUE UNIVERSITY
DEPARTMENT OF GENERAL ENGINEERING
LAFAYETTE, INDIANA

Dear Sir:

What is your concept of "Industrial Engineering"?

A preliminary survey indicates that a wide difference of opinion exists as to the nature and scope of "Industrial Engineering". Some companies look upon it as the science of designing industrial control systems and coordinating the activities of an industry, while others identify "Industrial Engineering" with only one or two specific functions such as Time & Motion Study or Plant Layout.

We would greatly appreciate your filling out the enclosed questionnaire and returning it to us as soon as possible, even though you may not have a formal Industrial Engineering Department or hire Industrial Engineers. You are one of a group of leading U.S. companies we are asking to help us with this survey. Should you prefer not to furnish the requested information, please return the uncompleted questionnaire as we will then submit it to another comparable company in order to keep our selected group representative.

We feel that the information you furnish will assist us in revising our "Industrial Engineering" curriculum to meet the increasing demands of Industry for graduates trained for management and industrial engineering positions. (You can help yourself by helping us to do a better job.)

This survey is being conducted as part of a Masters Degree Thesis project. We would appreciate receiving your reply this month in order that your data and information can be included in the project. You may be assured that your company's name will not be used or disclosed in any way.

Thank you for your cooperation in this project.

Sincerely yours,

R. E. Balyeat

R. E. Balyeat
Assistant Professor of
Industrial Engineering

Sincerely yours,

R. E. Balyeat

R. E. Balyeat
Assistant Professor of
Industrial Engineering

Fig. 2

Letter Sent to Manufacturers, Public Utilities, and Department Stores

PURDUE UNIVERSITY
DEPARTMENT OF GENERAL ENGINEERING
LAFAYETTE, INDIANA

April 17, 1953

Mr. Everett Laitala
Professor of Industrial Engineering
Mechanical Engineering Department
Case Institute of Technology
Cleveland, Ohio

Dear Sir:

What is your concept of "Industrial Engineering"? Some look upon it as the science of designing industrial control systems and coordinating the activities of an Industry, while others identify "Industrial Engineering" with only a few specific functions such as Time and Motion Study or Incentive System Control.

We are conducting a survey of approximately 1000 representative industrial firms in an effort to ascertain their practices and concepts. In addition the questionnaire is being submitted to numerous leading educators and consulting engineers to obtain their opinions. We anticipate that the information secured will be of immeasurable benefit to schools offering Industrial Engineering or Management courses as well as to consulting firms in this field.

Will you kindly indicate your concepts on the enclosed form and return it at your earliest convenience, together with any comments you may have. This survey is being conducted as part of a Master's Degree Thesis project, and we would appreciate an immediate reply in order that your data may be included in the summarization.

Thank you for your cooperation.

Sincerely,

R. E. Balyeat
Asst. Professor of
Industrial Engineering

REB/ph

Sincerely,

R. E. Balyeat
Asst. Professor of
Industrial Engineering

REB/ph

Fig. 3

Letter Sent to Educators and Management Consulting Firms

Table 1

INDUSTRY TYPES

Industry	Description
Food	Food, beverages and kindred products
Tobacco	Tobacco manufactures
Textiles	Textile mill products
Apparel	Apparel and related products
Lumber	Lumber and wood products (except furniture)
Furniture	Furniture and fixtures
Paper	Paper and allied products
Printing	Printing and publishing industries
Chemicals	Chemicals and allied products
Petroleum	Petroleum and coal products
Rubber	Rubber products
Leather	Leather and leather products
Clay	Clay, stone and glass products
Metal	Primary metal products
Fab. Metal	Fabricated metal products
Machinery	Machinery (except electrical)
Elec. Mach.	Electrical machinery
Transport.	Transportation Equipment
Instruments	Instruments and related products
Miscellaneous	Miscellaneous manufactures

The Bureau of the Census has divided industry into these twenty major types for convenience in presenting information in the annual Statistical abstract of the United States (op. cit.).

Table 2

GEOGRAPHIC AREAS OF THE UNITED STATES

Area Symbol	Area Name	States Included
NE	North Eastern	Connecticut Maine Massachusetts New Hampshire Rhode Island Vermont
MA	Middle Atlantic	New Jersey New York Pennsylvania
ENC	Eastern North Central	Illinois Indiana Michigan Ohio Wisconsin
WNC	Western North Central	Iowa Kansas Minnesota Missouri Nebraska North Dakota South Dakota
SA	Southern Atlantic	Delaware Florida Georgia Maryland North Carolina South Carolina Virginia West Virginia Washington, D.C.
ESC	Eastern South Central	Alabama Kentucky Mississippi Tennessee
WSC	Western South Central	Arkansas Louisiana Oklahoma Texas
M	Mountain	Colorado Idaho Montana Nevada New Mexico Utah Wyoming
P	Pacific	California Oregon Washington

The Bureau of the Census has divided the United States into these nine major areas for convenience in presenting information in the annual Statistical Abstract of the United States (op. cit.).

Table 3

QUESTIONNAIRE DISTRIBUTION

Industry Type	Geographical Area									Total
	NE	MA	ENC	WNC	SA	ESC	WSC	M	P	
Food	4	18	26	15	10	4	7	3	12	99
Tobacco	1	2			1	1				5
Textiles	19	23	3	1	36	6	1		1	89
Apparel	5	36	9	3	10	3		1	4	71
Lumber	3	3	6	2	13	7	6	2	12	54
Furniture	2	5	9	1	5	1	1		1	25
Paper	5	9	10	3	3	1	2		3	36
Printing	4	15	14	3	2	1		2	5	46
Chemicals	1	11	10	1	2	1			3	29
Petroleum	1	1				2	2	1		7
Rubber	3	2	8		1				1	15
Leather	9	1	5	2	2	1				20
Clay	2	10	9		3	1	2	1	2	30
Metal	5	22	32			1	1			61
Fab. Metal	11	17	34	5	3	3	1		4	78
Machinery	13	19	59	4		1	2		6	104
Elec. Mach.	10	14	31	5	2				1	67
Transport.	4	10	45	3	2	1	1	1	4	71
Instruments	2	10	3	1					3	19
Miscellaneous	7	13	11	4	3	1			1	40
Public Util.	3	2	2	2	2	2	2	2	2	19
Dept. Stores	3	4	3		2		1		3	16
Consultants	1	6	9		1					17
Educators	6	20	17	6	8	4	10	4	7	82
Total	123	277	355	61	111	42	39	17	75	1100

available any indication of the number of employees. The respondents were asked to indicate on the questionnaire the numbers of employees in their company in order that an analysis of the replies could be made on this basis. The information so obtained is presented in Table 6.

Mailing List

The mailing list for the 1001 manufacturers and 17 management consulting firms was prepared from Thomas' Register of American Manufacturers[5] and Poor's Register of Directors and Executives[6]. The list of 42 educators was obtained from the Industrial Engineering listing in The Journal of Engineering Education[7].

Analysis of Replies

The tabulation and analysis of the replies received is presented in the "Results and Analysis" section of this thesis.

---

[5] Thomas' Register of American Manufacturers, Ed. 47, vol. 1-3, New York, Thomas Publishing Company, 1952.

[6] Poor's Register of Directors and Executives, United States and Canada, New York, Standard and Poor's Corporation, 1953.

[7] The Journal of Engineering Education, Yearbook, XLIII, 6 (February, 1953), 35-106, 1054-20.

RESULTS AND ANALYSIS

The results obtained in this survey are presented and analyzed in the tables and pages that follow.

Response to Questionnaire

1100 questionnaires were mailed April 21, 1953, and by May 8, 1953, the date the replies were tabulated for this thesis, 314 replies had been received. The relatively high percentage of replies (28.5%) in so short a time was most gratifying.

Table 4 shows the number of replies received by type of industry and geographical area.

Table 5 shows the percentage of replies received by type of industry and geographical area.

Analysis of Replies

The majority of the 314 replies received had every question answered. In some cases, however, one or more questions were left unanswered or were answered in such a manner as to make interpretation doubtful or impossible. For this reason, each question is analyzed separately, and any statistics or percentages given will, for the most part, be based on the number of usable replies to that question.

Questions 1, 3, & 4. These questions were intended primarily for identification of the respondents and to provide background information for the analysis of other parts of the questionnaire. However, the replies proved of little value in the present analysis and are not presented here.

Question 2. This question asked the respondents to indicate the approximate number of employees in their companies. The replies are tabulated in Table 6.

Table 4

NUMBER OF REPLIES RECEIVED

Industry Type	Geographical Area									Total
	NE	MA	ENC	WNC	SA	ESC	WSC	M	P	
Food		6	7	4	2	2			3	24
Tobacco					1	1				2
Textiles	1	3			7	1			1	13
Apparel		7	4		4					15
Lumber	1		2		2	1			2	8
Furniture		1	4		1					6
Paper	2	3	2	1	1					9
Printing	3	6	5	2	1			1	2	20
Chemicals		1	4						1	6
Petroleum	1						1			2
Rubber			3		1					4
Leather			1	1	1	1				4
Clay	1	3	3				1			8
Metal	2	5	9				1			17
Fab. Metal	5	6	12	3	1	1			1	29
Machinery	6	9	22	1			1		4	43
Elec. Mach.	3	2	11		2					18
Transport.	2	4	8	1		1				17
Instruments	2	3	1						1	7
Miscellaneous	1	2	3	4						10
Public Util.					1	1		2	2	6
Dept. Stores		2	1						2	5
Consultants		2	6							8
Educators	4	9	5	3	1		7		4	33
Total	34	74	114	20	26	9	11	3	23	314

Table 5

PERCENTAGE OF QUESTIONNAIRES ANSWERED

Industry Type	Geographical Area									Total
	NE	MA	ENC	WNC	SA	ESC	WSC	M	P	
Food		33.3	26.9	26.7	2[illegible].0	5[illegible].0			25.0	[illegible].2
Tobacco					100.0	100.0				[illegible].0
Textiles	5.5	13.0			19.4	1[illegible].7			100.0	14.6
Apparel		1[illegible].4	44.4		40.0					21.1
Lumber	33.3		33.3		15.4	14.3			16.7	14.8
Furniture		20.0	44.4		20.0					21.0
Paper	40.0	33.3	20.0	33.3	33.3					25.0
Printing	75.0	40.0	35.7	66.7	50.0			50.0	40.0	43.5
Chemicals		9.1	40.0						33.3	20.7
Petroleum	100.0						50.0			28.6
Rubber			37.5		100.0					26.7
Leather			20.0	50.0	50.0	100.0				20.0
Clay	50.0	30.0	33.3				50.0			26.7
Metal	40.0	29.7	28.1				100.0			27.9
Fab. Metal	45.5	35.3	35.3	66.0	33.3	33.3			25.0	37.2
Machinery	46.2	47.4	37.3	25.0			50.0		66.7	41.3
Elec. Mach.	30.0	11.1	35.5		100.0	10[illegible].0				26.9
Transport.	50.0	40.0	20.0	33.3						23.9
Instruments	100.0	3[illegible].0	33.3						33.3	36.8
Miscellaneous	14.3	15.4	27.3	100.0						25.0
Public Util.					50.0	5[illegible].0		100.0	100.0	31.6
Dept. Stores		50.0	33.3						66.7	31.3
Consultants		3[illegible].3	66.7							47.1
Educators	6[illegible].7	45.0	29.4	50.0	12.5		70.0		57.1	40.2
Total	2[illegible].0	26.7	32.1	32.8	23.4	21.4	28.2	17.6	30.7	28.5

Table 6

DISTRIBUTION OF REPLIES RECEIVED BY COMPANY SIZE

Number of Employees	Number of Replies
1-250	22
251-500	44
501-750	30
751-1000	21
1001-1500	31
1501-2000	23
2001-3000	22
3001-5000	20
5001-10,000	23
Over 10,000	17
	Total 270

Question 5. The first part of question 5 asked the respondents to indicate whether or not they hire graduate Industrial Engineers. Tables 7, 8, and 9 show the response by industry type, geographical area and company size, respectively. The number of respondents who hire graduate Industrial Engineers was approximately three times as great as the number of respondents who do not hire graduate Industrial Engineers. It should be noted that this ratio was reversed in the case of very small companies (1-250 employees) as shown in Table 9. Of special interest were 10 respondents who said that they had not hired any graduate Industrial Engineers to date but planned to do so in the near future.

Tables 10 and 11 show, by industry type and geographical area, the relationship between the employment of graduate Industrial Engineers and the existence of formal Industrial Engineering departments (see Question 7). Of particular interest in Table 10 are 7 companies that have a formal Industrial Engineering department but indicate that they do not employ graduate Industrial Engineers.

Table 12 lists the average number of graduate Industrial Engineers per company as related to company size. The average increases proportionately from 1.7 for the smallest companies to 2[illegible].7 for the largest companies, with an overall average of [illegible].0 graduate Industrial Engineers per company. Management consulting firms are not included in this table, since their organization is substantially different from that of ordinary industry.

Table 13 indicates the utilization of graduate Industrial Engineers in industry. The average is [illegible].5 per company, with only 7 industry types exceeding the average appreciably. The average number of employees

Table 7

ANSWERS TO PART 1 OF QUESTION 5 BY INDUSTRY TYPE

Question 5: Does your company hire college graduates who have "Industrial Engineering" or "Industrial Engineering-Option" degrees? Yes___ No___

Industry Type	Yes		No		No (Might)	
	Number	Percent.	Number	Percent.	Number	Percent.
Food	11	47.8	11	47.8	1	4.4
Tobacco	2	100				
Textiles	10	76.9	2	15.4	1	7.7
Apparel	9	60.0	6	40.0		
Lumber	3	42.9	4	57.1		
Furniture	5	83.3	1	16.7		
Paper	3	42.9	3	42.9	1	14.2
Printing	12	60.0	7	35.0	1	5.0
Chemicals	4	66.6	1	16.7	1	16.7
Petroleum			1	100		
Rubber	4	100				
Leather	3	75.0	1	25.0		
Clay	4	57.1	2	28.6	1	14.3
Metal	15	88.2	2	11.8		
Fab. Metal	18	72.0	6	24.0	1	4.0
Machinery	29	72.5	10	25.0	1	2.5
Elec. Mach.	14	77.8	3	16.7	1	5.5
Transport.	10	66.6	4	26.7	1	6.7
Instruments	6	100				
Miscellaneous	9	90.0	1	10.0		
Public Util.	5	100				
Dept. Stores	4	80.0	1	20.0		
Consultants	7	100				
Total (263)	187	71.1	66	25.1	10	3.8

The column "No (Might)" is used here to indicate companies that intend to hire or are interested in hiring college graduates with Industrial Engineering degrees.

Table 8

ANSWERS TO QUESTION 5 BY GEOGRAPHICAL AREA

Question 5: Does your company hire college graduates who have "Industrial Engineering" or "Industrial Engineering-Option" degrees? Yes____ No____

Geographical Area	Yes		No		No (Might)	
	Number	Percent	Number	Percent	Number	Percent
NE	25	86.2	4	13.8		
MA	45	72.6	15	24.2	2	3.2
ENC	69	68.3	28	27.7	4	4.0
WNC	10	66.7	3	20.0	2	13.3
SA	16	66.6	7	29.2	1	4.2
ESC	5	62.5	2	25.0	1	12.5
WSC	3	75.0	1	25.0		
M	1	50.0	1	50.0		
P	13	72.3	5	27.8		
Total (263)	187	71.1	66	25.1	10	3.8

The column "No (Might)" is used here to indicate companies that intend to hire or are interested in hiring college graduates with Industrial Engineering degrees.

Table 9

ANSWERS TO QUESTION 5 BY NUMBER OF EMPLOYEES

Question 5: Does your company hire college graduates who have "Industrial Engineering" or "Industrial Engineering-Option" degrees? Yes___ No___

Number of Employees	Yes		No		No (Might)	
	Number	Percent.	Number	Percent.	Number	Percent.
1-250	4	20.0	14	70.0	2	10.0
251-500	26	59.1	15	34.1	3	6.8
501-750	19	65.5	9	31.0	1	3.5
751-1000	19	63.3	10	33.3	1	3.4
1001-1500	22	73.3	8	26.7		
1501-2000	21	87.5	1	4.2	2	8.3
2001-3000	17	85.0	3	15.0		
3001-5000	16	88.9	2	11.1		
5001-10,000	13	72.3	4	17.4	1	4.3
Over 10,000	17	100				
Total (255)	179	70.2	66	25.9	10	3.9

The column "No (Might)" is used here to indicate companies that intend to hire or are interested in hiring college graduates with Industrial Engineering degrees.

Table 10

EMPLOYMENT OF GRADUATE INDUSTRIAL ENGINEERS RELATED TO EXISTENCE OF FORMAL INDUSTRIAL ENGINEERING DEPARTMENT - BY INDUSTRY TYPE

Companies:
A - Employ Industrial Engineers; have an Industrial Engineering Dept.
B - Employ Industrial Engineers; have no Industrial Engineering Dept.
C - Have no Industrial Engineers; have an Industrial Engineering Dept.

Industry Type	A		B		C	
	Number	Percent	Number	Percent	Number	Percent
Food	7	53.8	4	30.8	2	15.4
Tobacco	1	100				
Textiles	8	80.0	2	20.0		
Apparel	5	55.5	4	44.5		
Lumber	1	33.3	2	66.7		
Furniture	3	60.0	2	40.0		
Paper			3	100		
Printing	6	46.2	6	46.2	1	7.6
Chemicals	3	75.0	1	25.0		
Petroleum						
Rubber	3	75.0	1	25.0		
Leather	2	66.7	1	33.3		
Clay	1	25.0	3	75.0		
Metal	9	60.0	6	40.0		
Fab. Metal	11	73.7	4	21.1	1	5.2
Machinery	14	45.2	14	45.2	3	9.6
Elec. Mach.	9	64.3	5	35.7		
Transport.	5	50.0	5	50.0		
Instruments	3	42.9	4	57.1		
Miscellaneous	6	66.7	3	33.3		
Public Util.	1	20.0	4	80.0		
Dept. Stores			4	100		
Total (186)	101	54.3	73	41.3	7	3.8

Table 11

EMPLOYMENT OF GRADUATE INDUSTRIAL ENGINEERS AS RELATED TO EXISTENCE OF FORMAL INDUSTRIAL ENGINEERING DEPARTMENT - BY GEOGRAPHICAL AREA

Companies:
A - Employ Industrial Engineers; have an Industrial Engineering Dept.
B - Employ Industrial Engineers; have no Industrial Engineering Dept.
C - Have no Industrial Engineers; have an Industrial Engineering Dept.

Geographical Area	A		B		C	
	Number	Percent	Number	Percent	Number	Percent
NE	10	20.0	15	[illegible]		
MA	22	50.0	21	47.7	1	2.3
ENC	44	68.7	19	[illegible]	1	1.6
WNC	5	41.7	5	41.7	2	16.6
SA	7	50.3	7	47.7		
ESC	3	50.0	2	33.3	1	16.7
WSC	1	33.3	2	66.7		
M	1	100				
P	6	40.0	7	[illegible]	2	13.3
Total (196)	101	54.3	78	41.9	7	3.8

Table 12

EMPLOYMENT OF GRADUATE INDUSTRIAL ENGINEERS RELATED TO COMPANY SIZE

Number of Employees	Total Number of Companies	Total Number of Industrial Engineers	Average Number of Industrial Engineers per Company
1-250	3	5	1.7
251-500	23	70	3.0
501-750	19	75	4.0
751-1000	16	73	4.6
1001-1500	21	98	4.7
1501-2000	10	42	4.2
2001-3000	14	100	7.1
3001-5000	13	143	11.0
5001-10,000	11	93	13.7
Over 10,000	16	410	25.7
Total	166	1037	6.2

Table 13

UTILIZATION OF INDUSTRIAL ENGINEERS BY INDUSTRY TYPE

Industry Type	Number of Companies	Total Number of Employees	Total Number of Indust. Engr's.	Indust. Engr's. per Company	Employees per Indust. Engr.	Percent of all Indust. Engr's. (1415)
Food	9	20,150	30	3.3	672	2.2
Tobacco	1	12,000	4	4.0	3000	0.3
Textiles	10	45,911	57	5.7	823	4.0
Apparel	9	28,450	23	2.6	889	1.6
Lumber	3	1,950	11	3.7	177	0.8
Furniture	5	2,910	13	2.6	224	0.9
Paper	2	2,350	4	2.0	1675	0.3
Printing	12	19,715	85	7.1	232	6.0
Chemicals	4	4,650	42	10.5	111	3.0
Petroleum						
Rubber	3	6,300	9	3.0	700	0.6
Leather	3	27,600	16	5.3	1727	1.2
Clay	4	7,150	49	12.3	146	3.5
Metal	14	50,625	94	6.7	539	6.6
Fab. Metal	15	35,150	156	10.4	225	11.0
Machinery	22	52,810	188	8.5	280	13.3
Elec. Mach.	14	107,800	234	16.7	461	16.5
Transport.	10	64,250	96	9.6	677	6.8
Instruments	6	24,550	43	7.2	571	3.0
Miscellaneous	8	34,560	149	18.6	232	10.5
Public Util.	3	24,100	31	10.3	777	2.2
Dept. Stores	2	21,500	3	1.5	9483	0.2
Consultants	6	605	78	13.0	8	5.5
Total	166	587,598	1415	8.5	422	100

ber graduate Industrial Engineer is only [illegible]. It is interesting to note that more than half of all the graduate Industrial Engineers reported in industry are employed in four of the industry types: Fabricated Metals, Machinery, Electrical Machinery, and Miscellaneous.

Question 6. This question presented a list of 41 subjects frequently included in college Industrial Engineering curricula. The respondents were asked to rate these subjects as being (1) essential, (2) of some value, or (3) unimportant, in the training of college graduates hired by their company to perform "Industrial Engineering" or "Management" functions.

Table 14 is a listing of the subjects ranked in order of importance based on the ratings given by all educators.

Table 15 is a listing of the subjects ranked in order of importance based on the ratings given by all industries replying, by companies employing graduate Industrial Engineers, and by companies not employing graduate Industrial Engineers.

Comparison of the ranking by all industries reporting with the ranking by companies employing graduate Industrial Engineers shows only minor difference. Only 4 subjects differed in rank by as much as 3 places. Of these 4 subjects, all industries reporting ranked Plant Operation, Time-Job Valuation, and Labor Relations-Personnel higher, and Production Control lower, than did the companies hiring graduate Industrial Engineers.

Comparison of the ranking by all industries reporting with the ranking of companies not employing graduate Industrial Engineers shows only minor differences. Only three subjects differed in rank by as much as 5 or 7 places. Of these 3 subjects, all industries reporting

Table 14

SUBJECTS INCLUDED IN COLLEGE INDUSTRIAL ENGINEERING CURRICULA
IN ORDER OF IMPORTANCE AS REPORTED BY 23 EDUCATORS

Rank	Subject
1	Motion and Time Study
2	Accounting
3	Mathematics
4	Operation Analysis
5	Industrial Organization and Management
6	Labor Relations, Personnel
7	Mechanics
8	Physics
9	Plant Layout
10	Factory Planning
11	Production Planning
12	Mechanical Drawing
13	Technical Writing
14	Strength of Materials
15	Engineering Materials
16	Production Control
17	Engineering Economy
18	Statistics
19	Technical English
20	Economics
21	Production Engineering
22	Electrical Engineering
23	Plant Operation
24	Wages, Job Evaluation
25	Quality Control
26	Industrial Economics
27	Tool Engineering
28	Business Law
29	Thermodynamics
30	Machine Design
31	Human Engineering
32	Safety Engineering
33	Mechanisms
34	Chemistry
35	Metallurgy
36	Surveys and Reports
37	Fluid Mechanics
38	Industrial Reports
39	Finance
40	Government and Political Science
41	Surveying

Table 15

SUBJECTS FREQUENTLY INCLUDED IN COLLEGE INDUSTRIAL ENGINEERING CURRICULA IN ORDER OF IMPORTANCE AS REPORTED BY INDUSTRY

Rank	All Industry (254 Companies)	Companies Employing Industrial Engineers (184 Companies)	Companies not Employing Industrial Engineers (70 Companies)
1	Mathematics	Mathematics	Plant Operation
2	Plant Layout	Operation Analysis	Plant Layout
3	Operation Analysis	Motion and Time Study	Mathematics
4	Plant Operation	Plant Layout	Production Engineering
5	Motion and Time Study	Factory Planning	Wages, Job Evaluation
6	Production Engineering	Production Engineering	Operation Analysis
7	Factory Planning	Plant Operation	Factory Planning
8	Wages, Job Evaluation	Production Control	Production Planning
9	Production Planning	Production Planning	Mechanical Drawing
10	Mechanics	Mechanics	Labor Rel., Personnel
11	Production Control	Wages, Job Evaluation	Motion and Time Study
12	Mechanical Drawing	Mechanical Drawing	Mechanics
13	Labor Rel., Personnel	Ind'l. Org'n. and Mg't.	Production Control
14	Ind'l. Org'n. and Mg't.	Human Engineering	Quality Control
15	Human Engineering	Industrial Reports	Ind'l. Org'n. and Mg't.
16	Industrial Reports	Labor Rel., Personnel	Human Engineering
17	Quality Control	Surveys and Reports	Safety Engineering
18	Surveys and Reports	Engineering Economy	Industrial Reports
19	Engineering Economy	Quality Control	Surveys and Reports
20	Industrial Economics	Industrial Economics	Physics
21	Physics	Statistics	Engineering Economy
22	Statistics	Physics	Industrial Economy
23	Safety Engineering	Technical Writing	Machine Design
24	Technical Writing	Technical English	Statistics
25	Technical English	Safety Engineering	Accounting
26	Accounting	Accounting	Mechanisms
27	Mechanisms	Mechanisms	Tool Engineering
28	Machine Design	Machine Design	Economics
29	Economics	Economics	Technical English
30	Tool Engineering	Engineering Materials	Electrical Engineering
31	Engineering Materials	Tool Engineering	Technical Writing
32	Electrical Engineering	Electrical Engineering	Strength of Materials
33	Strength of Materials	Strength of Materials	Chemistry
34	Chemistry	Finance	Engineering Materials
35	Finance	Chemistry	Metallurgy
36	Metallurgy	Metallurgy	Fluid Mechanics
37	Fluid Mechanics	Fluid Mechanics	Finance
38	Business Law	Business Law	Thermodynamics
39	Thermodynamics	Thermodynamics	Business Law
40	Gov't. and Pol. Sci.	Gov't. and Pol. Sci.	Surveying
41	Surveying	Surveying	Gov't. and Pol. Sci.

ranked Motion and Time Study and Technical Writing higher, and Safety Engineering lower, than did companies not employing graduate Industrial Engineers.

Comparison of the ranking by companies employing graduate Industrial Engineers with the ranking by companies not employing graduate Industrial Engineers shows only minor differences. Only 5 subjects differed in rank by as much as 6 to 9 places. Of these 5 subjects, the companies hiring graduate Industrial Engineers ranked Motion and Time Study and Technical Writing higher, and Plant Operation, Wage-Job Evaluation, Labor Relations-Personnel, and Safety Engineering lower, than did companies not hiring graduate Industrial Engineers.

Comparison of the ranking by the industrial executives with the ranking by educators shows important differences in nearly every subject. Nine subjects differed in rank by 15 to 21 places. Of these 9 subjects, the educators ranked Accounting, Strength of Materials, and Engineering Materials higher, and Industrial Reports, Plant Operation, Surveys and Records, Wage-Job Evaluation, Human Engineering, and Production Engineering lower, than did all industries reporting. This, in itself, indicates the need for a better understanding of the field of Industrial Engineering.

Table 15 lists these additional subjects suggested by respondents for inclusion in college Industrial Engineering curricula.

Question 7. This question asked whether or not the company's organization specifically included an "Industrial Engineering" department. In instances where the answer was "yes" the respondents were asked to indicate (a) the title of the head of this department, (b) to whom he reports, and (c) approximately how many employees are in this

Table 16

ADDITIONAL SUBJECTS SUGGESTED BY INDUSTRY FOR [illegible] IN COLLEGE INDUSTRIAL ENGINEERING CURRICULA

Number of Times Mentioned	Subject
6	Public Speaking
5	Psychology
5	English (Composition, Literature)
1	Speed Reading
1	How to Present Plans to Management
1	Logic
1	Ethics
1	Filing Systems
1	Office Methods
1	Operations Research
1	Estimating Manufacturing Times
1	Field Trips to Industry
1	Laboratory and Shop Work Machine Tools Foundry Inspection
1	Sanitary Engineering
1	History
1	Industrial Ecology
1	Industrial Sociology
1	Comparative Religion

department.

Analysis of the replies to the first part of this question indicated the necessity for classifying the replies in four categories, designated as follows:

A. Companies whose organization is officially includes a formal "Industrial Engineering" department and who answered the question "yes".

B. Companies whose organization does not specifically include a formal "Industrial Engineering" department but who answered the question "yes". These companies have organized special departments to perform Industrial Engineering functions, and the title of the department is usually one descriptive of the major Industrial Engineering function performed, such as "Methods", "Standards", etc.

C. Companies whose organization is the same as "B" above, but who answered the question "no".

D. Companies whose organization does not include a formal Industrial Engineering department or a special department to perform Industrial engineering functions and who answered the question "no".

Tables II and IV comprise the answers to the first part of Question 7 according to industry type, geographic area, and company size.

Table IV contains the average size of Industrial Engineering departments and company size.

Table VI lists the titles used by various companies according to the heads of formal Industrial Engineering departments.

Table VI lists the titles used by various companies according to heads of special departments performing Industrial Engineering functions where there is no formal Industrial Engineering department.

Table VII lists various titles of those heads of formal and special Engineering departments in part.

Table VII lists company officers to whom heads of special departments

Table 17

EXISTENCE OF FORMAL INDUSTRIAL ENGINEERING DEPARTMENT
AS RELATED TO TYPE OF INDUSTRY

Question 7: Does your company's organization specifically include an "Industrial Engineering" department? Yes___ No___

A - Answered YES. Have an Industrial Engineering department.
B - Answered YES. No Industrial Engineering Department. Have organized special departments such as "Standards", "Methods", etc., to perform Industrial Engineering functions.
C - Answered NO. Same as "B"
D - Answered NO. No Industrial Engineering department. No special departments.

Industry Type	Total Number of Companies	Total		A		B		C		D	
		Percent YES	Percent NO	Number YES	Percent YES	Number YES	Percent YES	Number NO	Percent NO	Number NO	Percent NO
Food	23	39.1	60.9	7	30.5	2	8.7	1	4.3	13	56.5
Tobacco	1	100		1	100						
Textiles	13	61.5	38.5	5	38.5	3	23.0			5	38.5
Apparel	14	35.7	64.3	5	35.7			1	7.1	8	57.2
Lumber	8	12.5	87.5	1	12.5					7	87.5
Furniture	5	60.0	40.0	3	60.0			1	20.0	1	20.0
Paper	8	12.5	87.5	1	12.5			4	50.0	3	37.5
Printing	21	28.6	71.4	4	19.0	2	9.5	6	28.6	9	42.9
Chemicals	6	50.0	50.0	3	50.0					3	50.0
Petroleum	1		100							1	100
Rubber	4	75.0	25.0	2	50.0	1	25.0	1	25.0		
Leather	4	50.0	50.0			2	50.0			2	50.0
Clay	7	28.6	71.4	1	14.3	1	14.3	1	14.3	4	57.1
Metal	17	52.9	47.1	7	41.2	2	11.8	3	17.6	5	29.4
Fabricated Metal	29	58.6	41.4	9	31.0	8	27.6	3	10.4	9	31.0
Machinery	40	45.0	55.0	14	35.0	4	10.0	8	20.0	14	35.0
Electrical Machinery	18	50.0	50.0	6	33.3	3	16.7	6	33.3	3	16.7
Transportation	17	29.4	70.6	5	29.4			5	29.4	7	41.2
Instruments	7	42.9	57.1	3	42.9			3	42.9	1	14.2
Miscellaneous	10	60.0	40.0	6	60.0			2	20.0	2	20.0
Public Utility	5	20.0	80.0	1	20.0					4	80.0
Department Stores	5		100					3	60.0	2	40.0
Total	263	42.6	57.4	84	31.9	28	10.6	48	18.3	103	39.2

Table 18

EXISTENCE OF FORMAL INDUSTRIAL ENGINEERING DEPARTMENT
AS RELATED TO GEOGRAPHIC AREA AND COMPANY SIZE

Question 7: Does your company's organization specifically include an "Industrial Engineering" department? Yes___ No___

A - Answered YES. Have an Industrial Engineering department.
B - Answered YES. No Industrial Engineering department. Have organized special departments such as "Standards", "Methods", etc., to perform Industrial Engineering functions.
C - Answered NO. Same as "B"
D - Answered NO. No Industrial Engineering department. No special departments.

Geographical Area	Total Number of Companies	Total		A		B		C		D	
		Percent YES	Percent NO	Number YES	Percent YES	Number YES	Percent YES	Number NO	Percent NO	Number NO	Percent NO
NE	30	33.3	66.7	6	20.0	4	13.3	8	26.7	12	40.0
MA	62	40.3	59.7	20	32.3	5	8.1	12	19.3	25	40.3
ENC	97	47.4	53.6	36	37.1	10	10.3	18	18.6	33	34.0
WNC	16	43.7	56.3	5	31.3	2	12.4	5	31.3	4	25.0
SA	25	36.0	64.0	6	24.0	3	12.0	3	12.0	13	52.0
ESC	8	50.0	50.0	3	37.5	1	12.5			4	50.0
WSC	4	50.0	50.0	1	25.0	1	25.0			2	50.0
M	2	50.0	50.0	1	50.0					1	50.0
P	19	42.1	57.9	6	31.6	2	10.5	2	10.5	9	47.4
Total	263	42.6	57.4	84	31.9	28	10.6	48	18.3	103	39.2
Company Size											
1-250	20		100					1	5.0	19	95.0
251-500	42	35.7	64.3	11	26.2	4	9.5	5	11.9	22	52.4
501-750	30	20.0	80.0	3	10.0	3	10.0	6	20.0	18	60.0
751-1000	30	50.0	50.0	14	10.0	1	3.3	5	16.7	10	33.3
1001-1500	32	50.0	50.0	11	34.4	5	15.6	6	18.7	10	31.3
1501-2000	25	48.0	52.0	9	36.0	3	12.0	6	24.0	7	28.0
2001-3000	20	50.0	50.0	8	40.0	2	10.0	6	30.0	4	20.0
3001-5000	19	57.9	42.1	10	52.6	1	5.2	4	21.1	4	21.1
5001-10,000	22	63.6	36.4	10	45.5	4	18.2	5	22.7	3	13.6
Over 10,000	21	52.4	47.6	7	33.3	4	19.0	4	19.0	6	28.7
Total	261	42.1	57.9	83	31.8	27	10.3	48	18.4	103	39.5

Table 19

SIZE OF INDUSTRIAL ENGINEERING DEPARTMENTS COMPARED WITH SIZE OF COMPANIES

Question 7: Does your company's organization specifically include an "Industrial Engineering" department? Yes____ No____

7c: Approximately how many employees in this department?_____

A - Answered YES. Have an Industrial Engineering department.
B - Answered YES. No Industrial Engineering department. Have organized special departments such as "Standards", "Methods", etc., to perform Industrial Engineering functions.
C - Answered NO. Same as "B".

1 - Number of companies reporting.
2 - Total number of employees in Industrial Engineering departments.
3 - Average number of employees in Industrial Engineering departments.

Company Size	Total			A			B			C		
	1	2	3	1	2	3	1	2	3	1	2	3
1-250												
251-500	16	111	6.9	9	76	8.4	7	35	5.0			
501-750	7	64	9.1	2	14	7.0	3	40	13.0	2	10	5.0
751-1000	14	178	12.7	13	148	11.4	1	30	30.0			
1001-1500	14	355	25.4	11	137	12.4	2	200	100.0	1	18	18.0
1501-2000	13	264	20.3	9	214	23.8	3	42	14.0	1	8	8.0
2001-3000	13	240	18.5	8	153	19.1	2	34	17.0	3	53	17.7
3001-5000	8	229	28.6	6	169	28.2	2	60	30.0			
5001-10,000	11	665	60.5	6	255	42.5	5	410	82.0			
Over 10,000	11	843	76.6	7	518	74.0	4	325	81.3			
Total	107	2949	27.6	71	1684	23.7	29	1176	40.6	7	89	12.7

Table 20

TITLES USED FOR HEADS OF FORMAL INDUSTRIAL ENGINEERING DEPARTMENTS

(Reported by 81 companies whose organization specifically includes a formal Industrial Engineering Department)

Number of Companies Using Title	Title of Department Head
31	Chief Industrial Engineer
18	Industrial Engineer
20	Industrial Engineering Department: Head, Manager, Director or Supervisor
1	General Industrial Engineer
1	Wage Administrator in charge of Industrial Engineering
4	Chief Engineer
2	Production Manager
1	Superintendent
1	Plant Engineer
1	Executive Vice President
1	Special Assistant to Vice President in charge of Operations
Total 81	

Table 21

TITLES USED FOR HEADS OF TECHNICAL DEPARTMENTS PERFORMING INDUSTRIAL ENGINEERING FUNCTIONS

(Reported by 47 companies whose organization does not specifically include a formal Industrial Engineering Department)

Number of Companies Using Title	Title of Department Head
7	Standards Department: Head, Manager or Director
4	Methods & Standards Department: Head or Manager
4	Methods Department: Head, Manager or Director
3	Methods Engineer or Chief Methods Engineer
2	Time Study Department: Head or Superintendent
2	Methods & Time Study Department: Head or Supervisor
1	Methods and Standards Engineer
1	Methods Standards and Plant Layout Department Supervisor
1	Standards, Time Study, & Estimating Department Supervisor
2	Methods and Planning Department: Engineer or Superintendent
4	Chief Methods Department Manager
2	Process Engineering Department: Chief or Supervisor
2	Production Engineering Department: Director or Head
2	Production Department Manager, or General Manager
1	Management Engineer
1	Engineering Department Head
3	Plant or Factory Engineer
1	Industrial Relations Department: Manager or Director
1	Plant Superintendent
1	Efficiency Department Manager

Total 47

Table 20

TITLES OF COMPANY OFFICIALS TO WHO[illegible] OF FORMAL INDUSTRIAL ENGINEERING DEPARTMENTS EXIST

Number of Companies Using Title	Titles of Company Officers
32	Plant, Works, Factory or Division: Manager, General Manager, Superintendent, or General Superintendent
27	Vice President
7	President
6	Production, Operations or Manufacturing: Manager or Director
2	Manufacturing or Operations: Engineer or Chief Engineer
1	Planning Manager
1	Engineering Director
3	Personnel or Industrial Relations: Manager or Director
Total 79	

Table 2)

TITLES OF COMPANY OFFICERS TO WHOM HEADS OF SPECIAL DEPARTMENTS PERFORMING INDUSTRIAL ENGINEERING FUNCTIONS REPORT

Number of Companies Using Title	Titles of Company Officers
15	Works, Factory, or Plant, Manager, General Manager, or Superintendent
6	Vice President
5	Manufacturing, or Production, Manager or Director
5	President
3	Personnel, or Industrial Relations, Director, or Manager
1	Assistant to Vice President of Manufacturing
1	Administrative Services Manager
1	Treasurer
1	Accounting Manager
1	Cost Director
1	Controller
1	Research Manager
Total 42	

[illegible] Industrial Engineering functions [illegible] Industrial Engineering department.

Question 6. The companies were asked to indicate whether or not they consider their Chief Industrial Engineer to be a member of "Top Management".

Many respondents gave their opinion, even though they did not actually have a Chief Industrial Engineer. In this way the question is broadly interpreted to include these opinions.

Tables 21 and 22 list the answers to Question 6 by industry type, geographical area, or company size. Analysis of the answers is also made on the basis of whether or not the companies manufacture industrial equipment or have a formal industrial engineering department or a special department performing Industrial Engineering functions.

The opinions of executives is also included in Table 23. It should be noted here that 61.5% of all respondents in industry do consider their Chief Industrial Engineer to be a member of Top Management, while only 16% of the executives felt the same way.

Question 7. This question asked the respondents to indicate who they felt should be responsible for the coordination and utilization of men, materials, and machines to achieve the most economical production. Table 24 lists the opinions of 72 respondents. The chief manager in this evaluation was mentioned 40 times. The Industrial Engineering Department and Industrial Engineer were mentioned specifically 30 times but were listed in the various answers 41 times.

Table 25 lists the opinions of 42 respondents who have formal Industrial Engineering departments or special departments performing Industrial Engineering functions. The plant manager or his equivalent

Table 24

OPINIONS REGARDING THE PLACE OF THE CHIEF INDUSTRIAL ENGINEER IN THE COMPANY ORGANIZATION--BY TYPE OF INDUSTRY

Question 8: Do you consider your Chief Industrial Engineer to be a member of "Top Management"? Yes____ No____

A - Have Industrial Engineers or an Industrial Engineering Department or a special department performing Industrial Engineering functions.
B - Do not have Industrial Engineers or an Industrial Engineering Department or a special department performing Industrial Engineering functions.

Opinions of Educators			
Number YES	Number NO	Percent YES	Percent NO
4	6	40	60

Industry Type	Total Number of Companies	Total		A				B			
		Percent YES	Percent NO	Number YES	Number NO	Percent YES	Percent NO	Number YES	Number NO	Percent YES	Percent NO
Food	16	75.0	25.0	9	3	75.0	25.0	3	1	75.0	25.0
Tobacco	1		100.0		1		100.0				
Textiles	11	63.6	36.4	6	3	66.7	33.3	1	1	50.0	50.0
Apparel	8	62.5	37.5	4	2	66.7	33.3	1	1	50.0	50.0
Lumber	4	75.0	25.0	1	1	50.0	50.0	2		100.0	
Furniture	4	100.0		4		100.0					
Paper	3	100.0		3		100.0					
Printing	14	42.9	57.1	4	5	44.4	55.6	2	3	40.0	60.0
Chemicals	4	25.0	75.0	1	3	25.0	75.0				
Petroleum											
Rubber	4	100.0		4		100.0					
Leather	4	50.0	50.0	2	1	66.7	33.3		1		100.0
Clay	5	60.0	40.0	1	2	33.3	66.7	2		100.0	
Metal	13	84.6	15.4	10	2	83.3	16.7	1		100.0	
Fabricated Metal	24	58.3	41.7	11	7	61.1	38.9	3	3	50.0	50.0
Machinery	27	66.7	33.3	15	9	62.5	37.5	3		100.0	
Electrical Machinery	14	64.3	35.7	9	3	75.0	25.0		2		100.0
Transportation Equip.	8	75.0	25.0	4	2	66.7	33.3	2		100.0	
Instruments	6	33.3	66.7	2	4	33.3	66.7				
Miscellaneous	10	60.0	40.0	5	4	55.6	44.4	1		100.0	
Public Utilities											
Department Stores	2	50.0	50.0		1		100.0	1		100.0	
Consultants	5	80.0	20.0	4	1	80.0	20.0				
Total	187	64.7	35.3	99	54	64.7	35.3	22	12	64.7	35.3

Table 25

OPINIONS REGARDING THE PLACE OF THE CHIEF INDUSTRIAL ENGINEER IN THE COMPANY ORGANIZATION--BY GEOGRAPHIC AREA AND COMPANY SIZE

Question 8: Do you consider your Chief Industrial Engineer to be a member of "Top Management"? Yes___ No___

A - Have Industrial Engineers or an Industrial Engineering Department or a special department performing Industrial Engineering functions.
B - Do not have Industrial Engineers or an Industrial Engineering Department or a special department performing Industrial Engineering functions.

Geographic Area	Total Number of Companies	Total		A				B			
		Percent YES	Percent NO	Number YES	Number NO	Percent YES	Percent NO	Number YES	Number NO	Percent YES	Percent NO
NE	20	50.0	50.0	9	9	50.0	50.0	1	1	50.0	50.0
MA	43	69.8	30.2	24	11	68.6	31.4	6	2	75.0	25.0
ENC	74	74.3	25.7	46	13	78.0	22.0	9	6	60.0	40.0
WNC	14	57.1	42.9	5	6	45.5	54.5	3		100.0	
SA	18	61.1	38.9	9	5	64.3	35.7	2	2	50.0	50.0
ESC	5	60.0	40.0	2	2	50.0	50.0	1		100.0	
WSC	3	33.3	66.7	1	2	33.3	66.7				
M											
P	10	30.0	70.0	3	6	33.3	66.7		1		100.0
Total	187	64.7	35.3	99	54	64.7	35.3	22	12	64.7	35.3
Number of Employees											
1-250	15	80.0	20.0	6	1	85.7	14.3	6	2	75.0	25.0
251-500	33	66.7	33.3	15	8	65.2	34.8	7	3	70.0	30.0
501-750	13	53.8	46.2	5	5	50.0	50.0	2	1	66.7	33.3
751-1000	21	66.7	33.3	12	6	66.7	33.3	2	1	66.7	33.3
1001-1500	23	52.2	47.8	12	8	60.0	40.0		3		100.0
1501-2000	19	47.4	52.6	7	10	41.2	58.8	2		100.0	
2001-3000	16	68.8	31.2	10	4	71.4	28.6	1	1	50.0	50.0
3001-5000	14	78.6	21.4	10	3	76.9	23.1	1		100.0	
5001-10,000	17	76.5	23.5	12	4	75.0	25.0	1		100.0	
Over 10,000	13	69.2	30.8	9	4	69.2	30.8				
Total	184	65.2	34.8	98	53	64.9	35.1	22	12	66.7	33.3

Table 26

OPINIONS REGARDING RESPONSIBILITY FOR THE COORDINATION AND UTILIZATION OF MEN, MATERIALS, AND MACHINES TO ACHIEVE THE MOST ECONOMICAL PRODUCTION

Times Mentioned	Department or Individual Responsible
36	Plant, Division, Factory or Works: Manager, General Manager, Superintendent or General Superintendent
37	Production, Manufacturing or Operations Department: Manager, Head or Superintendent
30	Industrial Engineering Department: Industrial Engineer or Chief Industrial Engineer
20	Vice President
16	Top Management: Chief Executive and Advisory Staff, including some Industrial Engineers
14	Manufacturing Line Organization: Foremen, Supervisors
6	Engineering Department: Director, Chief Engineer
3	Planning Department: Manager, Head
3	Plant Engineer
2	President
2	Time Study Department: Head
2	Manufacturing Engineering Department: Director
2	Production Control Department: Supervisor
2	Personnel Director
1	Methods Department: Head
1	Standards Department: Head
1	Tool Engineer
1	Master Mechanic
1	Experienced Technical Engineer

Total 229 (All respondents)

Table 27

OPINIONS REGARDING RESPONSIBILITY FOR THE COORDINATION AND UTILIZATION OF MEN, MATERIALS, AND MACHINES TO ACHIEVE THE MOST ECONOMICAL PRODUCTION IN INDUSTRIES HAVING INDUSTRIAL ENGINEERING DEPARTMENTS OR SPECIAL DEPARTMENTS PERFORMING INDUSTRIAL ENGINEERING FUNCTIONS

Times Mentioned	Department of Individual Responsible
42	Plant, Factory, Division or Works: Manager, General Manager, Superintendent or General Superintendent
24	Industrial Engineering Department: Industrial Engineer or Chief Industrial Engineer
17	Production or Manufacturing Department: Manager, Head, Superintendent
11	Vice President
10	Manufacturing Line Organization: Foremen, Supervisors
3	Engineering Department: Chief Engineer, Director
3	Planning Department: Manager, Head
2	Production Control Department: Manager, Supervisor
2	Manufacturing Engineering Department: Director
2	Time Study Department: Head
2	Plant Engineer
2	Committee: Top Management and Industrial Engineers
1	Standards Department: Head
1	Tool Engineer
1	Methods Department: Head
1	Top Management
Total 120	

was mentioned 10 times. Industrial Engineers were mentioned 14 times.

Table V lists the opinions of the students not having a formal Industrial Engineering department or a special department performing Industrial Engineering functions. The Industrial Engineers were mentioned specifically only 2 times and as members of top-level advisory staffs 11 times.

Question 11. This question asked: "Does your company engage 'Industrial Engineering' consultants: (check one) Regularly___ For Special Problems___ Never___."

Tables IV and V list the answers received by industry type, geographical area, and company size. Approximately 71% engage consultants for special problems. Approximately 7% have never engaged consultants, and only about 14% engage them regularly. The type of industry, geographical area, and company size had no effect on these percentages. Of companies not having a formal Industrial Engineering department or special department performing Industrial Engineering functions 81.8% engage consultants for special problems and 18.2% have never engaged consultants.

Concept of Industrial Engineering Functions. The survey questionnaire presented a list of functions frequently associated with Industrial Engineering, and suggested that they could be thought of as consisting of two phases of activity:

Design: The study, planning and development of the methods, procedures, or systems required to control the performance of the function.

Administration: The actual performance or control of the function utilizing the designed methods, procedures, or systems.

The respondents were asked to indicate whether or not they associate these functions with "Industrial Engineering".

Table 28

OPINIONS REGARDING RESPONSIBILITY FOR THE COORDINATION AND UTILIZATION OF MEN, MATERIALS, AND MACHINES TO ACHIEVE THE MOST ECONOMICAL PRODUCTION IN INDUSTRIES NOT HAVING INDUSTRIAL ENGINEERING DEPARTMENTS OR SPECIAL DEPARTMENTS PERFORMING INDUSTRIAL ENGINEERING FUNCTIONS

Times Mentioned	Department or Individual Responsible
54	Plant, Factory or Works: Manager, General Manager, Superintendent, or General Superintendent
24	Production, Manufacturing, or Operations Department: Manager, Superintendent, Head
11	Top Management: Chief Executive and Advisory Staff, including Industrial Engineers
9	Vice President
6	Industrial Engineer or Chief Industrial Engineer
4	Line Management Organization: Foremen, Supervisors
3	Engineering Department: Chief Engineer
2	President
2	Personnel Director
1	Plant Engineer
1	Master Mechanic
1	Experienced Mechanical Engineer
Total 117	

Table 29

UTILIZATION OF "INDUSTRIAL ENGINEERING" CONSULTANTS BY TYPE OF INDUSTRY

Question 10: Does your company engage "Industrial Engineering" consultants: (check one) Regularly__ For special problems__ Never__

A - Companies employing Industrial Engineering graduates or having an Industrial Engineering department or having a special department to perform Industrial Engineering functions.

B - Companies not employing Industrial Engineering graduates and not having an Industrial Engineering department.

Industry Type	Total Number of Answers	Total			A						B					
		Percent Regular	Percent Special	Percent Never	Number Regular	Number Special	Number Never	Percent Regular	Percent Special	Percent Never	Number Regular	Number Special	Number Never	Percent Regular	Percent Special	Percent Never
Food	23		82.6	17.4		11	2		84.6	15.4		8	2		80.0	20.0
Tobacco	1		100			1			100							
Textiles	13		76.9	23.1		8	2		80.0	20.0		2	1		66.7	33.3
Apparel	15	13.3	86.7		2	7		22.2	77.8			6			100	
Lumber	6		66.7	33.3		2			100			2	2		50.0	50.0
Furniture	6		100			5			100			1			100	
Paper	8		62.5	37.5		2	2		50.0	50.0		3	1		75.0	25.0
Printing	19		63.2	36.8		9	3		75.0	25.0		3	4		42.9	57.1
Chemicals	6		66.7	33.3		3	1		75.0	25.0		1	1		50.0	50.0
Petroleum	1		100									1			100	
Rubber	4		75.0	25.0		3	1		75.0	25.0						
Leather	3		66.7	33.3		2			100				1			100
Clay	7	14.3	57.1	28.6	1	3		25.0	75.0			1	2		33.3	66.7
Metal	16		93.8	6.2		13	1		92.9	7.1		2			100	
Fab. Metal	27	11.1	66.7	22.2	2	15	2	10.5	78.0	10.5	1	3	4	12.5	37.5	50.0
Machinery	41	2.4	63.4	34.2	1	21	10	3.1	65.6	31.3		5	4		55.6	44.4
Elec. Mach.	16		62.5	37.5		8	5		61.5	38.5		2	1		66.7	33.3
Transport.	13	7.7	76.9	15.4	1	7	1	11.1	77.8	11.1		3	1		75.0	25.0
Instruments	7		100			7			100							
Miscellaneous	10	10.0	70.0	20.0	1	7	1	11.1	77.8	11.1			1			100
Public Util.	4		25.0	75.0		1	3		25.0	75.0						
Dept. Stores	5		100			3			100			2			100	
Total	251	3.6	72.9	23.5	8	138	34	4.4	76.7	18.9	1	45	25	1.4	63.4	35.2

Table 30

UTILIZATION OF "INDUSTRIAL ENGINEERING" CONSULTANTS
BY GEOGRAPHICAL AREA AND COMPANY SIZE

Question 10: Does your company engage "Industrial Engineering" consultants: (check one) Regularly__ For special problems__ Never__

A - Companies employing Industrial Engineering graduates or having an Industrial Engineering department or having a special department to perform Industrial Engineering functions.

B - Companies not employing Industrial Engineering graduates and not having an Industrial Engineering department.

Geographical Area	Total Number of Answers	Total			A						B					
		Percent Regular	Percent Special	Percent Never	Number Regular	Number Special	Number Never	Percent Regular	Percent Special	Percent Never	Number Regular	Number Special	Number Never	Percent Regular	Percent Special	Percent Never
NE	28	7.1	64.3	28.6	2	17	5	8.4	70.8	20.8		1	3		25.0	75.0
MA	61	1.6	83.6	14.8	1	38	6	2.2	84.4	13.4		13	3		81.3	18.7
ENC	94	4.3	70.2	25.5	3	50	10	4.7	79.4	15.9	1	16	14	3.2	51.6	45.2
WNC	14	7.1	71.4	21.4	1	8	2	9.1	72.7	18.2		2	1		66.7	33.3
SA	24		70.8	29.2		10	5		66.7	33.3		7	2		77.8	22.2
ESC	8		75.0	25.0		4	2		66.7	33.3		2			100	
WSC	4	25.0	75.0		1	2		33.3	66.7			1			100	
M																
P	18		66.7	33.3		9	4		69.2	30.8		3	2		60.0	40.0
Total	251	3.6	72.9	23.5	8	138	34	4.4	76.7	18.9	1	45	25	1.4	63.4	35.2
Company Size																
1-250	20	5.0	75.0	20.0		5			100		1	10	4	6.7	66.7	26.6
251-500	41	2.4	63.4	34.2	1	17	7	4.0	68.0	28.0		9	7		56.3	43.7
501-750	25		72.0	28.0		12	3		80.0	20.0		6	4		60.0	40.0
751-1000	28	10.7	67.9	21.4	3	13	3	15.8	68.4	15.8		6	3		66.7	33.3
1001-1500	34	14.7	61.8	23.5	5	16	6	18.5	59.3	22.2		5	2		71.4	28.6
1501-2000	26	3.8	80.8	15.4	1	17	4	4.5	77.3	18.2		4			100	
2001-3000	19		84.2	15.8		14	1		93.3	6.7		2	2		50.0	50.0
3001-5000	18	5.6	72.2	22.2	1	12	3	6.3	75.0	18.7		1	1		50.0	50.0
5001-10,000	21		76.2	23.8		15	3		83.3	16.7		1	2		33.3	66.7
Over 10,000	18		77.8	22.2		14	4		77.8	22.2						
Total	250	4.8	71.6	23.6	11	135	34	6.1	75.0	18.9	1	44	25	1.4	62.9	35.7

Table 3[illegible] summarizes the opinions of industry, management consulting firms, and educators. It is immediately evident that the majority of the respondents associate the "Design" phase of these functions with "Industrial Engineering" more than the "Administration" phase.

In general, the consultants and educators associated the listed functions with "Industrial Engineering" more often than did the industrial group.

Some of the functions most frequently associated with Industrial Engineering are Methods Analysis and Standardization, Time Study, Rate Setting, Wage Incentive Systems, and Plant Layout. Those least often associated with Industrial Engineering are Labor Relations- Grievance Settlement, Personnel Policies and Procedures, Maintenance, Safety, Training, and Office Management and Procedures.

Industrial Engineering Problems. Respondents having Industrial Engineering departments were asked to indicate those "functions performed by their Industrial Engineering departments."

Table 33 outlines the actual performance of the functions by companies having Industrial Engineering departments. Again, "Design" is stressed over "Administration". The functions most often performed are Time Study, Rate Setting, Wage Incentive Systems, Office and Plant Layout, Cost Estimating-Production, Special Projects, Job Evaluation, and Process Engineering. The functions least often performed are Safety Programs, Maintenance, Labor Relations-Grievance Settlement, Personnel Policies and Procedures, Methods Analysis and Standardization, Training Programs, and Quality Control.

Table 33 lists [illegible] function the departments most often performing that function when the company's organizational set does not include a formal Industrial Engineering department.

Table 31

CONCEPTS OF INDUSTRIAL ENGINEERING FUNCTIONS

The survey questionnaire presented a list of functions frequently associated with Industrial Engineering, and suggested that they could be thought of as consisting of two phases of activity:

DESIGN - The study, planning and development of the methods, procedures, or systems required to control the performance of the function.

ADMINISTRATION - The actual performance or control of the function utilizing the designed methods, procedures, or systems.

The respondents were asked to indicate whether or not they regarded these functions as "Industrial Engineering" functions. The percentages listed represent affirmative answers and are based on total response indicated in column headings.

Function	235 Companies			7 Consultants			29 Educators		
	Design %	Admin. %	Both %	Design %	Admin. %	Both %	Design %	Admin. %	Both %
Production Planning & Scheduling	63.3	36.6	29.8	71.4	28.6	14.3	86.2	48.3	44.8
Production Control	52.3	36.2	24.3	85.7	28.6	28.6	79.3	51.7	41.4
Material Control	45.1	30.6	20.0	71.4	14.3	14.3	69.0	41.4	31.0
Inventory Control	37.9	24.2	14.9	57.1	14.3		55.2	34.5	24.1
Quality Control	40.9	31.9	22.6	57.1			72.4	55.2	44.8
Office & Plant Layout	82.5	50.2	47.7	85.7	57.1	57.1	96.6	51.7	51.7
Design of Equipment or Facilities	64.2	33.6	31.5	71.4	14.3	14.3	58.6	20.7	20.7
Tool Engineering, Jigs & Fixtures	52.7	31.1	29.4	85.7	14.3	14.3	79.3	48.3	41.4
Maintenance - Machinery & Equipment	34.0	21.7	14.9	28.6	14.3	14.3	27.6	24.1	10.3
Maintenance - Building & Facilities	30.2	21.3	13.6	28.6	14.3	14.3	17.2	17.2	6.9
Safety Programs	34.0	29.4	19.1	29.6	14.3	14.3	58.6	44.8	41.4
Waste Elimination & Salvage	59.1	40.4	31.5	85.7	14.3	14.3	72.4	51.7	37.9
Office Management & Procedures	34.5	18.7	11.9	85.7	14.3		55.2	27.6	24.1
Process Engineering	66.8	43.4	39.6	100.0	57.1	57.1	62.1	58.6	48.3
Methods Analysis & Standardization	87.2	66.8	62.1	100.0	71.4	71.4	96.6	69.0	65.5
Personnel Policies & Procedures	23.4	19.6	11.5	14.3	14.3		31.0	10.3	6.9
Training Programs - Supervisor	34.4	30.2	23.0	42.9	42.9	28.6	41.4	31.0	27.6
Training Programs - Production Worker	34.4	27.7	20.9	57.1	28.6	28.6	44.8	31.0	27.6
Labor Relations - Grievance Settlement	21.3	20.4	12.3	14.3	14.3		27.6	17.2	13.8
Job Evaluation	68.1	58.3	50.2	71.4	71.4	57.1	86.2	58.6	55.2
Merit Rating	38.3	33.2	24.3	42.9	42.9	28.6	58.6	31.0	27.6
Time Study	83.4	75.3	68.5	100.0	85.7	85.7	89.7	69.0	65.5
Rate Setting	75.7	68.1	60.0	85.7	100.0	85.7	86.2	62.1	58.6
Wage Incentive Systems	73.2	65.9	59.1	85.7	85.7	71.4	82.8	55.2	48.3
Cost Estimating-Production	65.5	54.9	46.8	85.7	85.7	71.4	79.3	31.0	31.0
Cost Records & Control	33.2	26.8	18.7	28.6	14.3		65.5	34.5	27.6
Special Projects	51.1	39.1	35.7	71.4	14.3	14.3	44.8	24.1	24.1

INDUSTRIAL ENGINEERING DEPARTMENT PRACTICES IN INDUSTRY

The survey questionnaire presented a list of functions frequently associated with Industrial Engineering, and suggested that they could be thought of as consisting of two phases of activity:

DESIGN - The study, planning and development of the methods, procedures, or systems required to control the performance of the function.

ADMINISTRATION - The actual performance or control of the function utilizing the designed methods, procedures, or systems.

Respondents having Industrial Engineering Departments were asked to indicate those functions performed by their Industrial Engineering departments. The percentages represent affirmative answers and are based on total response indicated in column heading

Function	84 Companies with I.E. Depts.		
	Design %	Admin. %	Both %
Production Planning & Scheduling	43.6	21.1	20.2
Production Control	38.6	21.1	17.5
Material Control	32.5	15.8	13.2
Inventory Control	24.6	9.6	7.9
Quality Control	19.3	14.0	10.5
Office & Plant Layout	68.4	51.8	46.5
Design of Equipment or Facilities	47.4	34.2	33.3
Tool Engineering, Jigs & Fixtures	40.4	30.7	29.8
Maintenance - Machinery & Equipment	15.8	13.2	10.5
Maintenance - Building & Facilities	11.4	7.9	7.0
Safety Programs	10.5	8.8	7.0
Waste Elimination & Salvage	44.7	29.8	26.3
Office Management & Procedures	21.1	7.9	7.0
Process Engineering	51.8	43.0	40.4
Methods Analysis & Standardization	13.2	9.6	78.9
Training Programs - Supervisor	20.2	16.7	14.9
Training Programs - Production worker	15.8	12.3	11.4
Labor Relations - Grievance Settlement	11.4	13.2	9.6
Job Evaluation	53.5	43.9	41.2
Merit Rating	18.4	13.2	12.3
Time Study	83.3	83.3	78,9
Rate Setting	80.7	78.9	74.6
Wage Incentive Systems	71.9	66.7	62.3
Cost Estimating - Production	62.3	57.0	52.6
Cost Records & Control	38.6	31.6	29.8
Personnel Policies & Procedures	13.2	9.6	78.9
Special Projects	56.1	49.1	44.7

Table 33

"INDUSTRIAL ENGINEERING" FUNCTIONS REPORTED BY DEPARTMENTS OTHER THAN FORMAL INDUSTRIAL ENGINEERING DEPARTMENT

Function	Departments Most Frequently Mentioned	Frequency
Production Planning & Scheduling	Production Control	40
	Production Planning & Scheduling	36
	Production	29
	Administration & Management	10
	Sales	7
	Engineering	5
Production Control	Production Control	47
	Production	37
	Production Planning & Scheduling	24
	Administration & Management	7
Material Control	Purchasing	34
	Production Control	33
	Production	20
	Production Planning & Scheduling	16
	Material Inventory	14
	Product Control & Inspection	10
	Administration & Management	7
Inventory Control	Purchasing	36
	Production Control	31
	Material Inventory	23
	Controller & Accounting	22
	Production Planning & Scheduling	15
	Production	14
	Administration & Management	5
Quality Control	Quality Control & Inspection	9[illegible]
	Production	10
	Engineering	10
	Administration & Management	6
	Research & Development	4
Office & Plant Layout	Engineering	45
	Administration & Management	12
	Office & Plant Layout	8
	Production	6
	Methods & Time Study	6
	Maintenance	6
Design of Equipment or Facilities	Engineering	84
	Maintenance	10
	Design	9
	Administration & Management	8

Table 33 (cont.)

Function	Departments Most Frequently Mentioned	Frequency
Tool Engineering - Jigs & Fixtures	Engineering	67
	Tool Design	12
	Tool Engineering	12
	Administration & Management	4
Maintenance - Machinery & Equipment	Maintenance	82
	Engineering	42
	Mechanical	10
	Production	9
	Administration & Management	7
Maintenance - Building & Facilities	Maintenance	89
	Engineering	42
	Production	7
	Mechanical	6
	Administration Management	6
Safety Programs	Personnel & Industrial Relations	89
	Safety	33
	Administration & Management	12
	Production	7
	Engineering	5
Waste Elimination & Salvage	Production	23
	Quality Control & Inspection	20
	Engineering	13
	Salvage	9
	Individual Departments	9
	Administration & Management	8
Office Management & Procedures	Fiscal	40
	Administration & Management	26
	Methods & Procedures	12
	Individual Departments	8
Process Engineering	Engineering	43
	Time Study & Methods	7
	Production	6
	Product Control	6
	Research & Development	4
Methods Analysis & Standardization	Time Study & Methods	22
	Engineering	11
	Production	9
	Administration & Management	6
Personnel Policies & Procedures	Personnel	134
	Administration & Management	16

Table 33 (cont.)

Function	Departments Most Frequently Mentioned	Frequency
Training Programs - Supervisor	Personnel	90
	Production	8
	Training	7
	Administration & Management	6
	Individual Departments	5
Training Programs - Production Worker	Personnel	77
	Production	15
	Individual Departments	10
	Training	7
	Administration & Management	6
Labor Relations - Grievance Settlement	Personnel & Industrial Relations	120
	Administration & Management	24
	Production	7
	Special Committee	4
	Individual Departments	3
Job Evaluation	Personnel & Industrial Relations	66
	Time Study & Methods	13
	Administration & Management	12
	Production	6
Merit Rating	Personnel & Industrial Relations	64
	Administration & Management	16
	Individual Departments	8
	Production	5
Time Study	Time Study & Methods	27
	Administration & Management	6
	Personnel & Industrial Relations	4
	Engineering	3
	Production	3
Rate Setting	Time Study, Methods & Rates	23
	Personnel	13
	Administration & Management	11
	Production	5
Wage Incentive Systems	Time Study, Methods & Rates	15
	Personnel & Industrial Relations	10
	Administration & Management	10
	Production	3
Cost Estimating - Production	Accounting & Cost	38
	Estimating	20
	Time Study & Methods	12
	Engineering	10
	Administration & Management	6
	Production	6

Table 33 (cont'd.)

Function	Departments Most Frequently Mentioned	Frequency
Cost Records & Control	Accounting & Fiscal	126
	Control	5
	Administration & Management	4
	Methods & Rates	3
Special Projects	Engineering	9
	Administration & Management	8
	Time Study, Methods & Rates	7
	Research	5

CONCLUSIONS

The results of this survey were most gratifying, and it is felt that the objective of this thesis (to provide information concerning the existing Industrial Engineering concepts and practices of a representative segment of industry and educators) has been achieved. A large number of replies were received, and many of the respondents evinced considerable interest in the survey. Nearly all of them expressed a desire to learn the results.

Unquestionably, Industrial Engineering is becoming generally accepted as a separate branch of Engineering, and Industry, recognizing the field's potential value, is anxious to know more about it. The large amount of detailed information presented in this thesis should be of great value to companies planning to incorporate Industrial Engineering functions into their organization and in establishing the duties and responsibilities of Industrial Engineering personnel.

Since the information obtained in the survey is quite specific in nature, it is best presented and summarized in tabular form, and the various tables in the "Results and Analysis" section should be consulted whenever specific information is desired. However, it is appropriate to make several general remarks here.

Of the companies reporting, nearly one-third have a formal Industrial Engineering department, and another one-third have some special group in their organization performing some of the more generally accepted Industrial Engineering functions.

Three-fourths of the companies reporting employ graduate Industrial Engineers, and several others indicated they intend to do so in the near future.

Most of the companies consider the Chief Industrial Engineer to be either a member of "Top Management" or an important advisor thereto. In most cases, the Industrial Engineering department head reported directly to the Plant Manager or Vice President.

Probably the most significant observation is that there is practically no agreement whatsoever between the opinions of industry and educators concerning the training needs of graduate Industrial Engineers. This emphasizes the need for a better understanding of the Industrial Engineering field.

Because of the interest expressed in this survey, and the importance of the information obtained, it is felt that a more detailed analysis of the results would increase their value considerably. However, such an analysis is beyond the scope of this thesis. Therefore, it is recommended that a more detailed analysis and evaluation of the data be conducted to determine specific applications and correlations with related information. It is also suggested that additional definitive studies should be made in the future to increase the knowledge and understanding of the Industrial Engineering field.

Thesis
W638 Wilson 20517
A survey of industrial engineering practices in industry.

FEB 17 4067
25 JUL 79 25818

Thesis
W633 Wilson 20517
A survey of industrial engineering practices in industry.

U. S. Naval Postgraduate School
Monterey, California

thesW638
A survey of industrial engineering pract
3 2768 001 90136 6
DUDLEY KNOX LIBRARY